United States Patent Application For

EXPANSION MOTOR

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Background of the invention

In manufacturing, engineering and scientific work often it is needed to clamp, or manipulate parts, or control a gap space between them. Arrays of devices are used to manipulate parts so new features can be created with proper relationship to existing features when machining parts. In power transmission trains shafts are coupled and pulleys are clamped in place. Optical alignment sometimes requires alignment in angstroms to split light beams. Before mentioned are some of tasks that deal with clearances or clamping ranges few thousands of an inch or millimeters. This work requires this excursion of a movable feature of these devices to be controlled within this barely visible range. In some instances as with a brake or clutch the movement is practically non measurable as a preload is being applied. That is, pressure on contacting surfaces is increased or decreased as with a brakes and clutches. Another example of micro inch movement is with the displacement of the mounting of variable stiffness hydraulic dampeners.

These type clamping is disclosed in an early example using an expandable sleeve is in U.S. Pat. No. 4,366,735 U.S. and later Pat. No. 6,077,003 each using seals of various materials. Other chucks and holding devices are shown by U.S. Pat. No. 5,127,780 and U.S. Pat. No. US 6,488,285 B1. A shortcoming of the gripping sleeves is that the preload on the compressible seals is reduced as the pressure expands or reduces the removable wall. Therefore, the increasing the hydraulic pressure reduces the sealing. Melted copper seals delaminate and fail under torsion loads. Also, highly stressed fusible alloy welds also fail with the internal pressures of cooling metals. An example of a device for positioning is U.S. Pat. No. 5,362,185 showing is a widening elastic rod. A fluid under elastic membrane is shown in U.S. Pat. No. 6,375,172.

Summary and objects of the invention

The present invention overcomes the disadvantages of the prior art expandable holders by having a deformable wall that is filleted with the inside walls to improve the range of motion and also to eliminate stress concentration thereby extending the life cycle expectancy. It is a further object of the invention to hold a workpiece stiffly. Yet another objective of the invention is a means to manipulate and hold the workpiece so the axis is independent of the holder axis. Still further the invention is an actuator to move a workpiece in very small movements whereby stiction is hardly a consideration.

It is a further objective of the invention that a pressure chamber having a thin wall with rounded inside corners around the perimeters to eliminate stressed concentrations known as stress risers. The patent also provides for a device that is heat treatable after fusion or welding to normalize and relieve internal stresses.

BREIF DESCRIPTION OF THE DRAWINGS

The object and the advantages of the invention will become apparent from the following detailed description of preferred embodiments thereof in connection with the accompanying drawings in which like designate like elements in which:

FIG. 1 is a side view of a motor body according to the present invention;

FIG. 2 is an orthographic end view described in **FIG. 1**;

FIG. 3 is a section view taken along line **3---3** of the motor body described in **FIG. 1**;

FIG. 3a is an enlargement of a section of **FIG. 3** showing construction and operation according to the present invention;

FIG. 3b is also an enlargement of a section **FIG. 3** showing another construction and operation body according to the present invention;

FIG. 4 is a end view of a expansion sleeve;

FIG. 5 is a side view of **FIG. 4**;

FIG. 5a is an enlarged view described in **FIG. 5**;

FIG. 6 is a side view of yet another configuration of the motor body according to the present invention;

FIG. 7 is a orthographic projection of the side view **FIG. 6;**

FIG. 7a is an enlarged view of a break out of **FIG. 7;**

FIG. 8 is a section view taken along line **8---8** of a motor body described in **FIG. 6**;

FIG. 8b is an enlargement of section view **FIG. 8** showing operation and another construction;

FIG. 8a is another enlargement of section view **FIG. 8** showing operation and another construction;

FIG. 9 is a plan view of the cover;

FIG. 10 is an orthographic projection of the side view **of FIG. 9**;

FIG. 11 is a side view taken along **11---11** of **FIG. 9**; **FIG. 1** is a side view of a motor body according to the present invention;

FIG. 12 is a side view of the motor according to the invention;

FIG. 13 is a orthographic end view of **FIG. 12**;

FIG. 14 is yet another configuration of the motor according to the present invention;

FIG. 15 is a section view taken **15---15** in **FIG. 14**;

FIG. 16 is a section view taken **16---16** in **FIG. 14**;

FIG. 16a is an enlarged view of view of **FIG. 16**;

FIG. 17 is a side view of another configuration of the motor according to the present invention;

FIG. 18 is an orthographic projection of the side view described in **FIG. 17**;

FIG. 19 is a section view taken along **14---14** of **FIG. 17**;

FIG. 19a is a enlarged view described in **FIG. 19**;

FIG. 20 is another configuration of the motor according to the present invention;

FIG. 21 is an orthographic projection of the side view described in **FIG. 20**;

FIG. 22 is a side view of a yet another motor body configuration according to the present invention;

FIG. 23 is an orthographic projection of the view described in **FIG. 22**;

FIG. 24 is a section view taken along line **24---24** described in **FIG. 23**;

FIG. 24a is an enlarged view described in **FIG. 24**;

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Depicted in **FIGS. 1-3** is a motor **1** when expansion sleeve **13** is my means expanded as shown by dashed line **4** in the direction indicated by arrow **6** according to the invention. In **FIG. 1** motor **1** comprising is comprised of a main body **11** and an expansion sleeve **13**. The main body **11** has a left face **12** and right face **14**. The faces **12** and **14** are defined by a shape **16**. In **FIG. 2** main body **11** has an annular cavity **24** with a thick bottom **20**. In **FIG. 3** annular thick bottom **20** is bounded laterally by annular thick walls **26**. The upper portion of thick wall **26** has a flexure **30** ending with an opening wall **32** generally perpendicular to the thick bottom **20** thereby providing annular opening **28**. Flexure **30** has an interior surface **34** being parallel to thick bottom **20**. The corner of surface **34** and thick wall **26** is rounded **34** to eliminate stress concentration. Service channel **38** connecting cavity **24** with and open to outside is removably blocked with check screw **40**. Pressure channel **42** also open to the outside is threaded to accept plunger **44** and is bored **46** to provide surface for seal **48**. **FIG. 3a** shows the expansion sleeve **13** having been joined with a fusible alloy **52**. Plunger **44** is screwed in direction indicated my movement arrow **50** this compressing fluid in confined cavity **24** causing expansion sleeve **13** to bilge **54**. Stress concentration is further relieved by groove **56**. **FIG. 3b** demonstrates expansion sleeve **13** with flange **60** having rounded corner **62** joined with fusible alloy **52** to thick wall **26**. In **FIG. 3c** annular cavity **24** is cast **66** in motor **1**. **FIG. 4-5** where **FIG. 4** is end view of expansion sleeve **13** and **FIG. 5** is a side view with a break out while **FIG. 5a** is a view to demonstrate another configuration of sleeve **13** having flange **60** and rounded corner **62.**

In **FIG. 6-8 FIG. 6** another configuration the motor **1** is in accordance to the present invention whereby expansion **70** is in direction shown by vector arrow **74**. Motor **1** has a main body **88** and an insert **90** with a stress relief groove **98** spaced from around the perimeter. In **FIG. 7** it is shown insert **90** is joined with a fusible alloy **89**. In **FIG. 8** the width of arch cavity **76** is bound radially by thick walls **78** and the length is by longitudinal thick walls **94**. Thereby arch cavity **76** has a bottom **80** and is surrounded by

walls **76** and **94** having a flexure protrusion **82** ending with opening wall **92** along the top edge and has an inside surface **84** that is with a rounded corner **86** to thick wall **76** and **94**. **FIG. 7a** is an example of insert **90** having a flange **92** around the inside wall **98** perimeter and a fillet **72**. **FIG. 7b** shows the motor **1** as a molded part **99**. Insert **90** is shown in **FIG. 9-11** with a plan view shown in **FIG. 9** and an orthographic view in **FIG. 10**.

Yet another configuration of the motor **1** according to the invention is demonstrated in **FIG. 12-15** is having motor **1** configuration arrayed plural radial around the body **102**. The force vectors **74** radiate approximately perpendicular to the center axis **100**.

Another configuration of the motor **1** according to the invention is demonstrated in **FIG. 14-16** is having a motor body **110** and thick arch sections **112**. In **FIG. 16** it is seen that main body has annular groove **114** with rounded corner **118** to relieve stress concentration with a remaining thin wall **122**. Groove **114** partially filled with arch sections **112** and all joins sealed with fusible alloy **52** resulting in cavity **116**. To further relieve stress annular inside groove **120** is grooved in inside wall **124**. When cavity **116** is pressurized thin wall is expanded **118** in direction of vector arrow.

In **FIG. 17-19** another configuration of the motor **1** is shown in **FIG. 17** in whereby expansion is area **150** in direction shown by vector arrow **152**. Motor **1** has a main body **156** and a cavity **158** extending to a thin wall 152 with a stress relief groove **160** spaced from around the perimeter of local area **152**. In **FIG. 18** it is shown that cavity **158** to a depth to provide for a thin wall **152** with fillet corners **166** further eliminate stresses. A congruent plug ~~168~~ 158 which provides space for cavity **170** is joined with a fusible alloy **89**.

Yet another configuration of the motor **1** according to the invention is demonstrated in **FIG. 20-21** is having motor **1** configuration arrayed plural radial around the body. The force vectors **152** converge approximately perpendicular to the center axis **100**.

Another configuration of motor **1** shown in **FIG. 22-24** according to the invention is taught in **FIG. 22** whereby expansion **170** is achieved in direction of vector arrow **180**. **FIG. 23** shows the body **168** with congruent plug **172** fused **174** to body **168**. In **FIG. 24** opening **178** extends to thin wall with congruent plug **172** providing for cavity. When cavity has pressure, thin wall **176** has bulge **170** in direction of vector arrow **170**. **FIG. 24a** shows the thin wall **176** bulge **170** with stress being taken with round corner **178** and groove **182** spaced around thin wall**176**.

The present invention may, of course, be carried out in other specific ways other than those herein set forth without departing from the spirit and essential characteristics of the invention. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive and all changes coming within the meaning and equivalency range of the append claims are intended to embraced therein.